Maternal Behavior of Tigers: Time Allocation in a Mother Tiger

An Honors Thesis (Honors 499)

By

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Thesis Advisor

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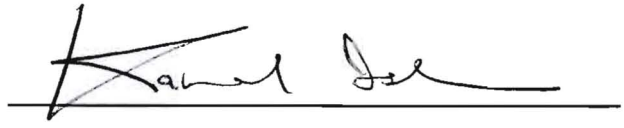

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Abstract:

This study recorded the maternal behavior of a tiger at the Fort Wayne Zoo. The tiger gave birth to three cubs and the zoo filmed the birth and the interactions between mother and cubs. This study was conducted remotely, using two cameras, so as not to interfere with the behavior of the tigers. Behaviors were recorded with focus on time allocations and unexpected displays or behaviors. Also, time allocation by the mother and the cubs, as well as other behaviors, were compared across the first month of the cubs lives to better understand how their behaviors change over time. Finally, explanations are proposed for the unexpected behaviors observed and recorded from the tapes.

Introduction:

Tigers (*Panthera tigris*) are a highly endangered species, and several subspecies are listed as critically endangered because of poaching and habitat destruction (Tiger Overview 2011). The greatest danger is the killing of female tigers to take their cubs for the pet trade (Karanth et al. 2006). Slow reproductive rates and high mortality among the young mean that even if populations are completely protected, it will take decades or centuries for populations to recover (Kerley et al. 2003). This puts a great importance on captive individuals for the survival of the species. If wild populations of tigers continue to dwindle or some subspecies go extinct in the wild, the large captive populations offer a glimmer of hope. In theory, these captive tigers could be used to repopulate the wild (Peilon 1987). This fact means that understanding all aspects of tiger biology is important, especially reproductive biology, so that captive born cubs have the best chance of survival.

The mating biology of tigers is well understood in captive populations; however, studying wild tigers is difficult as they are secretive. It is particularly difficult to study

the rearing of young cubs in wild populations, as the mother is extremely protective. If a den is disturbed, the mother will kill the intruder and move the cubs (Tigers 2011). Tigresses will mate about every other year in the wild, as cubs leave around age 20 months, whereas it is about only one year in captivity (Sankhala 1977). If a tigress loses her cubs, she may mate again within 2 weeks. Gestation lasts for just over 100 days. Similar to young of most predators, tiger cubs are born with their eyes closed, although their hearing and sense of smell is good. Sight will develop slowly over the next two to three months (Sankhala 1977). The average litter size is 2-3, but there can be up to six or even seven, and each tiger cub will weigh between 0.9 and 1.8 kilograms. By the time the cubs are two months old they have begun to eat meat, and are weaned by 6 months (Tigers 2011). At birth the sex ratio of the cubs is about even; however, adult sex ratios favor females. Cubs become active at less than one month of age and follow their mother once they are about two months old (Guggisberg 1975). Tigers reach sexual maturity between three and four years in the wild, but will mate at just two years of age in zoos. Also in the wild, some females have been with cubs from two litters but this is a rare occurrence (Guggisberg 1975).

Objectives:

1) Record the maternal behavior of a female tiger with young cubs, focusing on time allocation.
2) Observe and record unusual behaviors and suggest possible explanations for these behaviors.

Study Area:

The mother and three cubs were caged in two enclosures at the Fort Wayne Zoo, in Fort Wayne, Indiana, USA. The first enclosure was used as the den (Fig. 1). It was

completely enclosed on all four sides. It was approximately square and each wall was long enough for the mother to lie alongside it. On the floor of this enclosure was a mixture of sawdust and straw that was used as bedding. This substrate was used to simulate the natural den of tigers. In the wild, a tigress will build her birth den in thick grass or a overhang or cave covered in grass (Sankhala 1977). There was a camera in the upper corner of the den. On the wall furthest away from the camera was a door to the rest of the building, through which keepers had entry into the den. On the adjacent wall was a door that allowed the female access to the second enclosure. The roof of this second enclosure was much higher up than the den area (Fig. 1). Also, it was only enclosed by three solid walls. The fourth wall was a fence with a gate in it that allowed the keepers access to this enclosure. This had the same type of bedding as the den area. There was also a small cage off to the side of the outdoor enclosure, opposite the entrance to the den (Fig. 1). This was used to house the mother so keepers could clean the enclosures. The cameras were positioned remotely so as not to disturb the behavior of the cats.

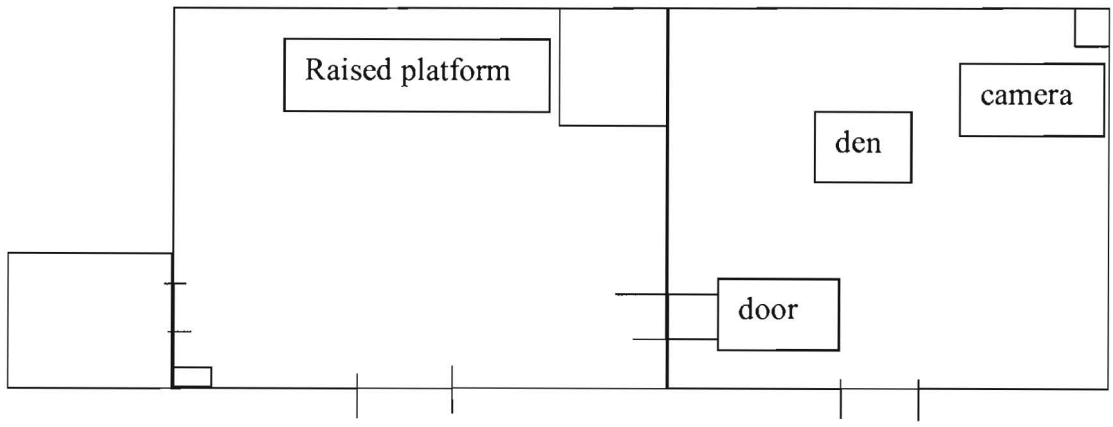

Figure 1. The enclosures used to house the tigress and cubs, with the den on the left and holding cage on the far right.

Methods:

To begin the study, I received copies of the tapes made by the Fort Wayne Zoo when one of its tigers gave birth. There were a total of 24 tapes after the cubs were born, covering 28 days and containing 550 hours of tape. I then watched the tapes just before the cubs were born until the cubs were about a month old. Once the cubs were born, I divided the tapes into four segments, each segment containing about a weeks worth of time, over the course of a month. Which watching the tapes, I recorded the behavior of both the mother and the cubs. When a behavior was observed, it was recorded in a large notebook. This book was divided into several sections, one for each tape, most of which spanned about a day to 36 hours. Along with the recording of the behavior, the time the behavior was noted and its durations were also written down for future analysis. Once all the data was entered into the notebook, the hand written notes were transferred into an Excel spreadsheet. This excel file contained 4 workbooks, one for each week, and each workbook contained 5-7 rows of data, one for each of the tapes used to gather data for that week (Appendix 1). Each behavior was recorded and under each behavior the number of times the behavior occurred, the total length of time for that behavior on the tape, or both were recorded. If a behavior was recorded in total time, then this raw data was converted into a percent of time for that tape. Once this had been done a total amount of time devoted to each behavior was compiled for that week. This week by week information was compared to look for changes in behavior over time. The results of this study were also compared to published results to see if they were consistent. Next, multiple week by week graphs were generated for a visual representation of how the

mother's behavior changed. These graphs included those for total time allocation, percent one verses two verses three cubs feeding and being cleaned, how long she spent outside, how long she spent cleaning herself and other behaviors. Graphs were also generated displaying how long one or more cubs spent outside and how long the cubs averaged feeding week by week. Finally χ^2 analysis was preformed on every behavior from week to week (α=0.05).

Results:

In every week, a large portion of the mothers time was spent feeding the cubs (51% in week one, 52% in week 2, 36% in week 3, and 17% in week 4, Figs. 2-5). The mother also spent a good deal of time cleaning the cubs, around 9-10% of her time each week. The mother spent very little time cleaning herself, (2.2 % in week 1, 1.2 % in week 2, 1.6% in weeks 3 and 4, figs. 2-5). Also in week 1, the mother spent 17% of her time out of the den, which increased to 26%, 44%, 78% in weeks 2, 3, and 4, respectively.

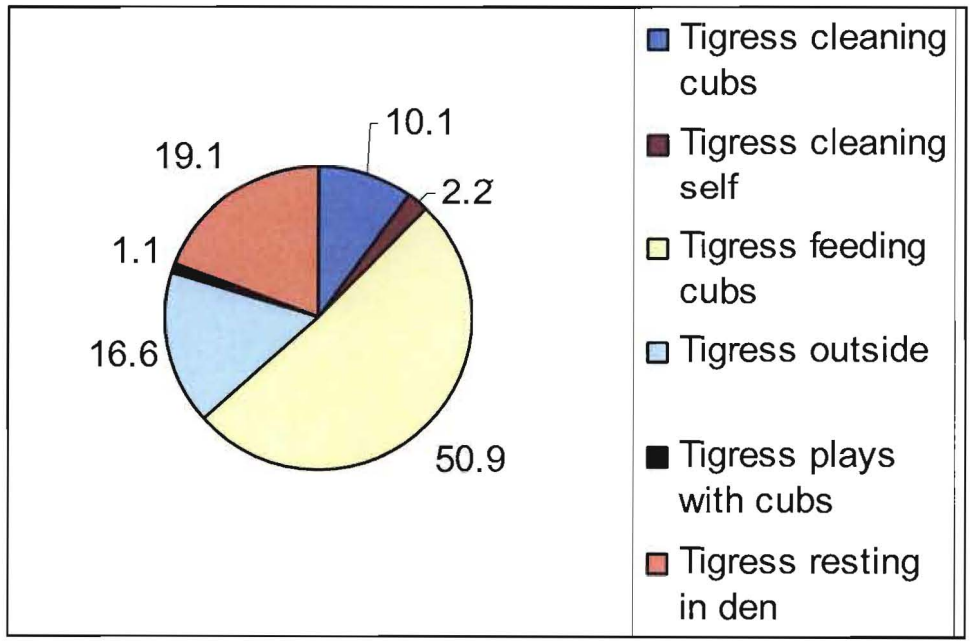

Figure 2. Time allocation of the mother tiger during the first week of the cubs' lives.

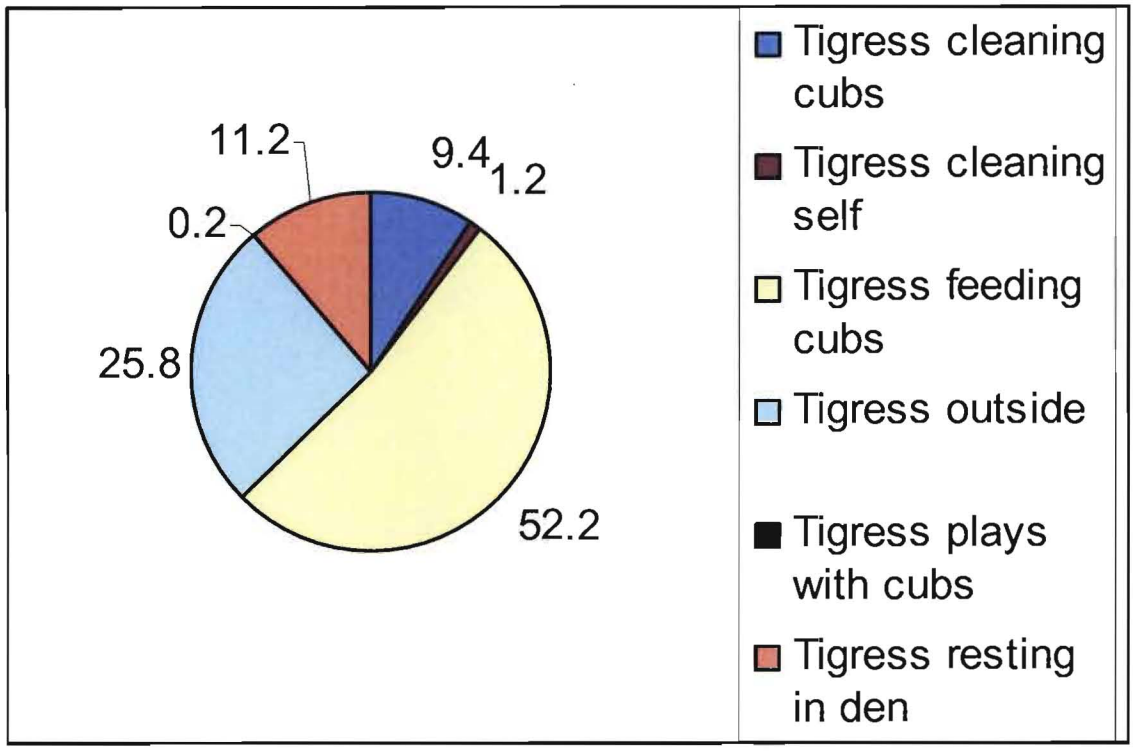

Figure 3. Time allocation of the mother tiger during the second week of the cubs' lives.

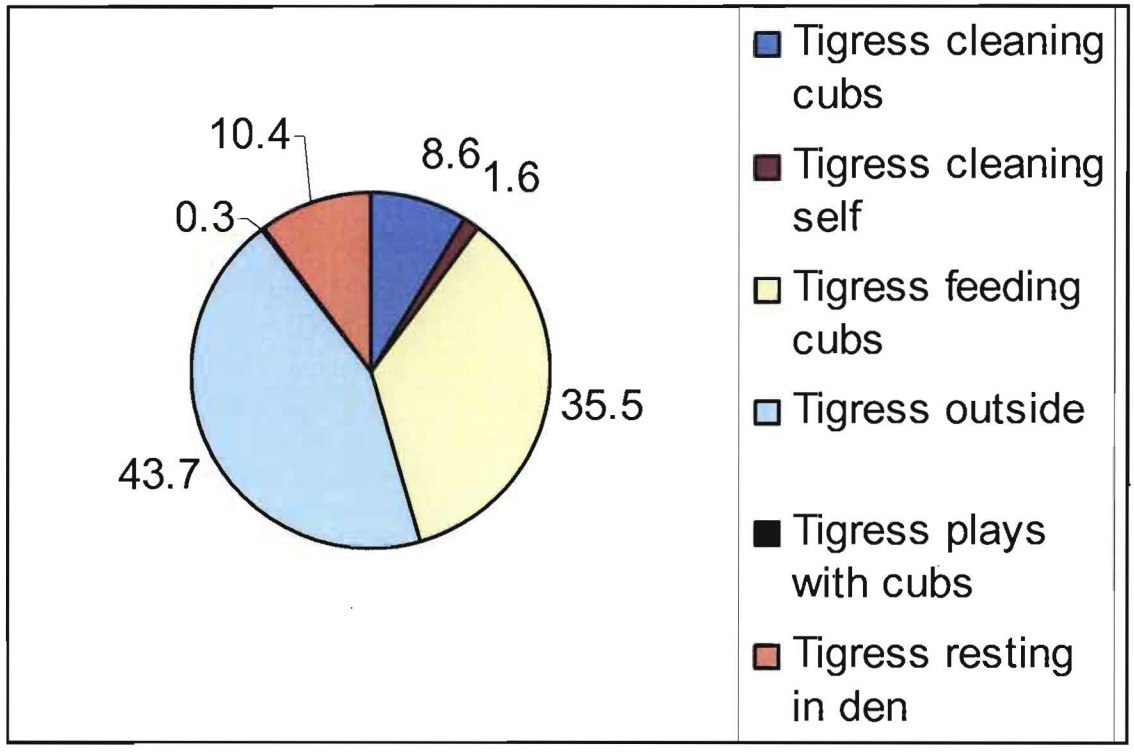

Figure 4. Time allocation of the mother tiger during the third week of the cubs' lives.

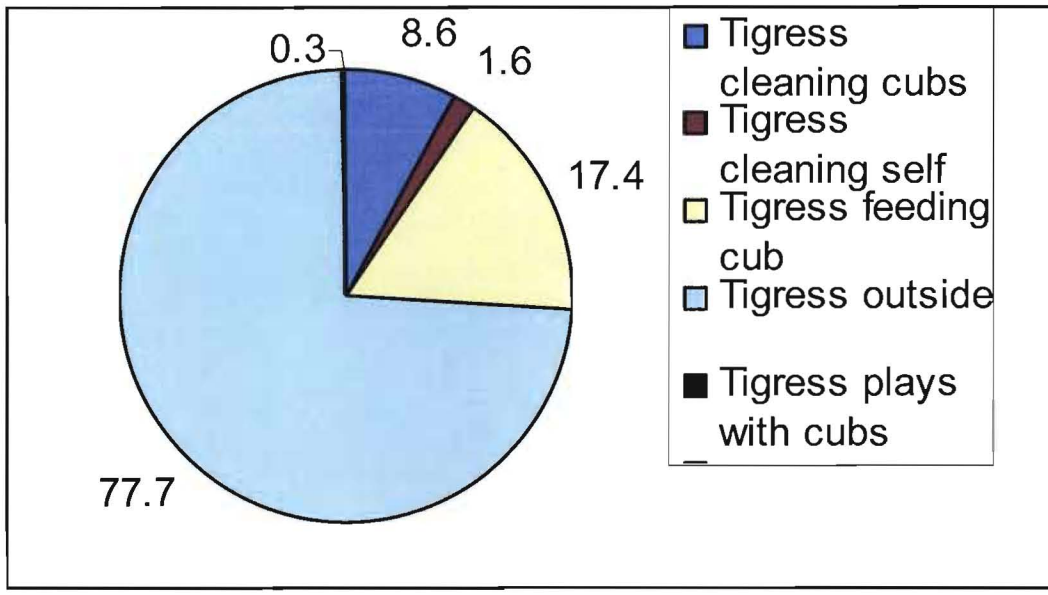

Figure 5. Time allocation of the mother tiger during the fourth week of the cubs' lives.

During the first three weeks of the study, the tigress spent most of the time nursing two cubs at once, but in week four, most of the time was devoted to feeding all three cubs at once (Fig. 6). In each week, the least amount of time was devoted to feeding one cub at a time. The tigress spent less and less time feeding the cubs each week, except week two.

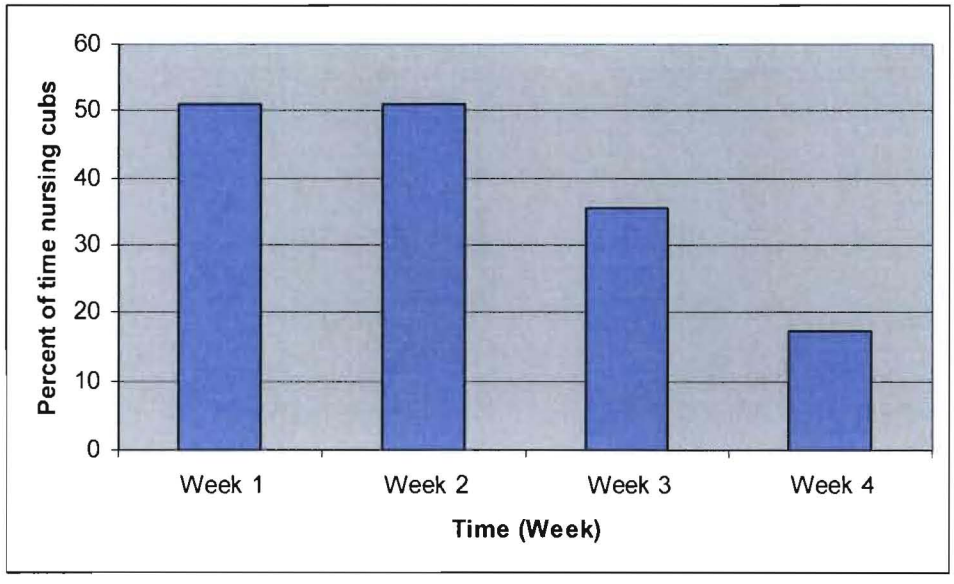

Figure 6. Percent of time mother spent nursing cubs each week.

During weeks 1-3, the mother devoted most of her nursing time to feeding two cubs, with one cub nursing a close second. In week 4, the mother spent more time nursing 1 cub as opposed to multiple cubs at the same time (Fig. 10). In every case she spent the least amount of time feeding all three cubs (Figs. 7-10).

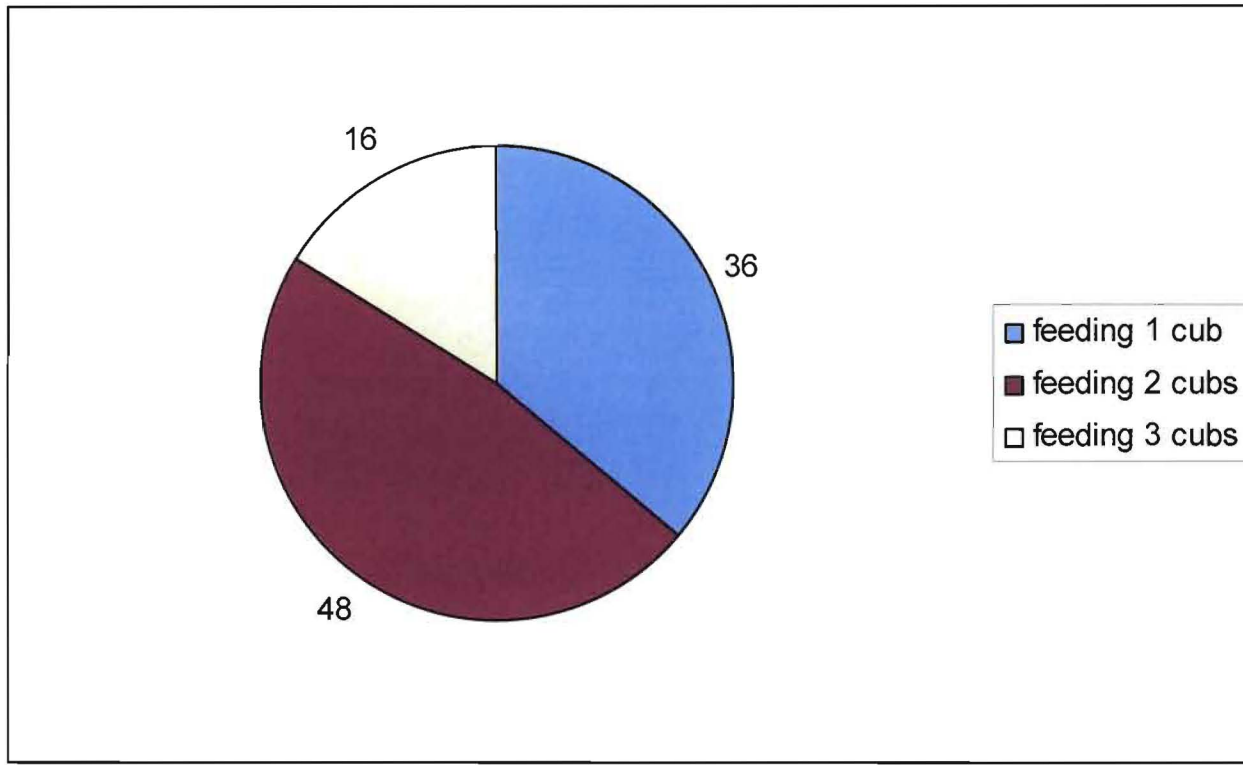

Figure 7. The percent of time spent by the mother nursing one, two, or three cubs, during week 1 of their lives.

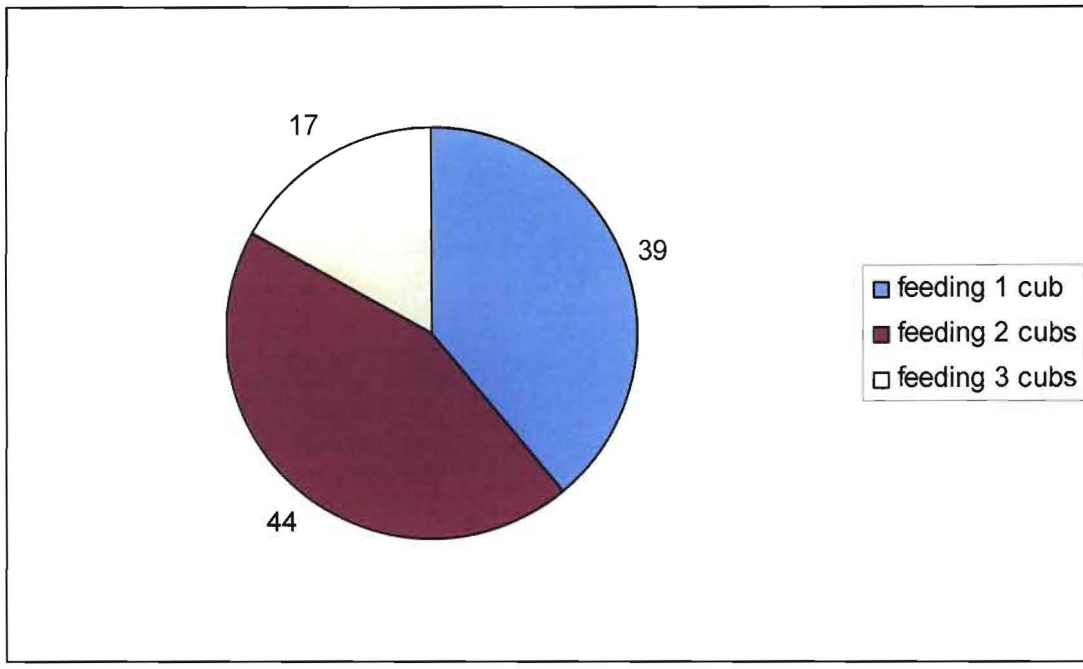

Figure 8. The percent of time spent by the mother nursing one, two, or three cubs, during week 2 of their lives.

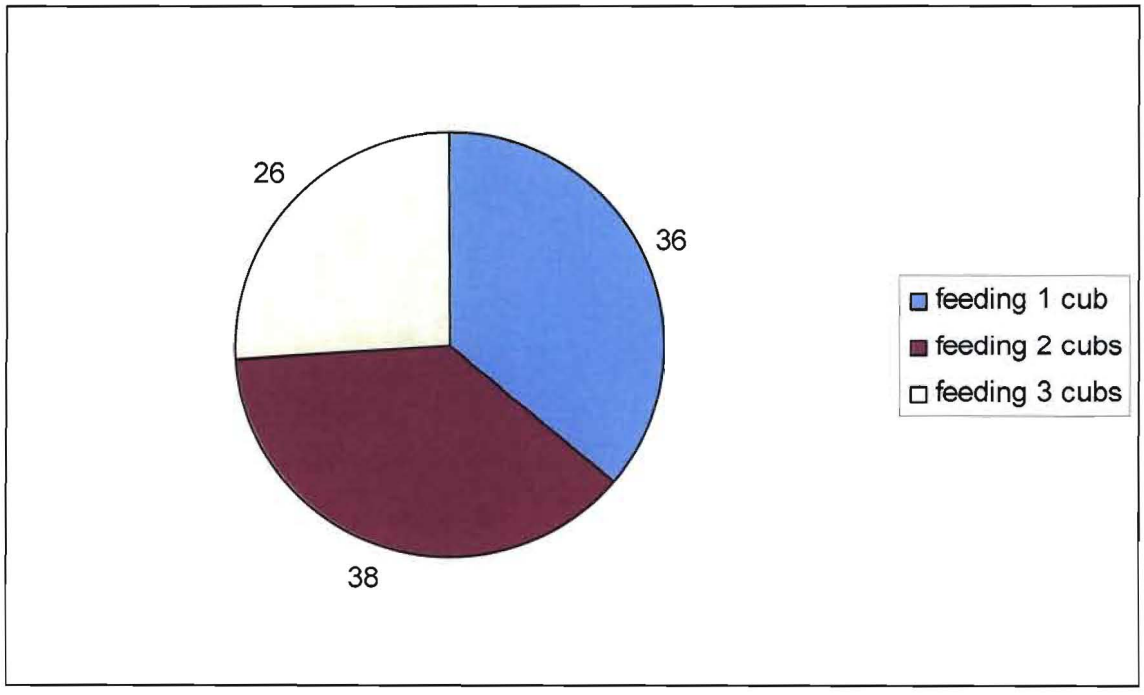

Figure 9. The percent of time spent by the mother nursing one, two, or three cubs, during week 3 of their lives.

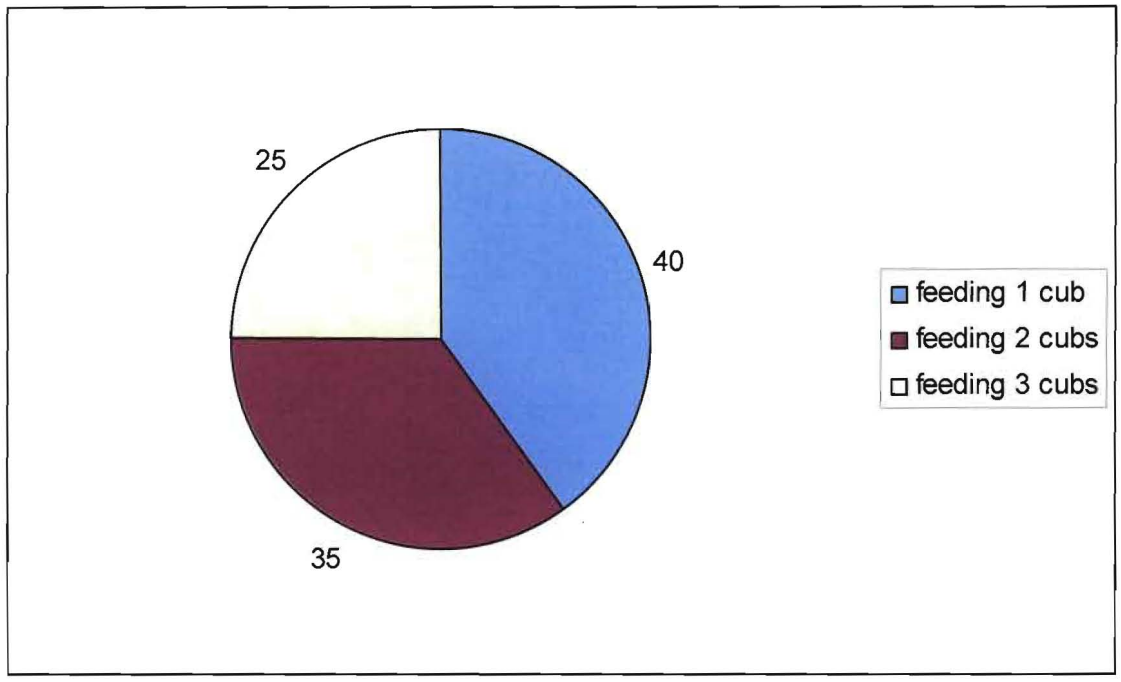

Figure 10. The percent of time spent by the mother nursing one, two, or three cubs, during week 4 of their lives.

The opposite trend was observed in how the mother tiger distributed her time when cleaning the cubs. In week 1, she spent 10.1% of her time cleaning cubs, whereas in weeks 3 and 4, it was down to 8.6% (Figs. 11). In each week, most of the time, (58% and 66%, Fig. 12-15), was devoted to cleaning only one cub. In all but week three she spent the least amount of time cleaning all three cubs; in week three she spent the least amount of time cleaning 2 cubs at once. Once again, as the month went on the percent of time devoted to cleaning cubs decreased, though not as dramatically.

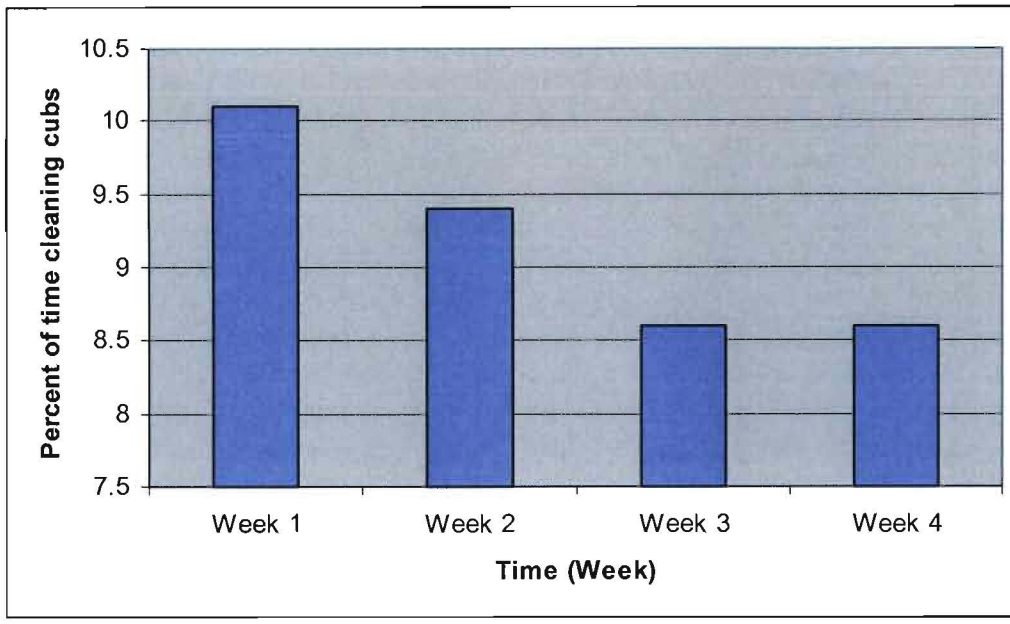

Figure 11. Percent of time the mother spent cleaning cubs week by week for the first month after birth.

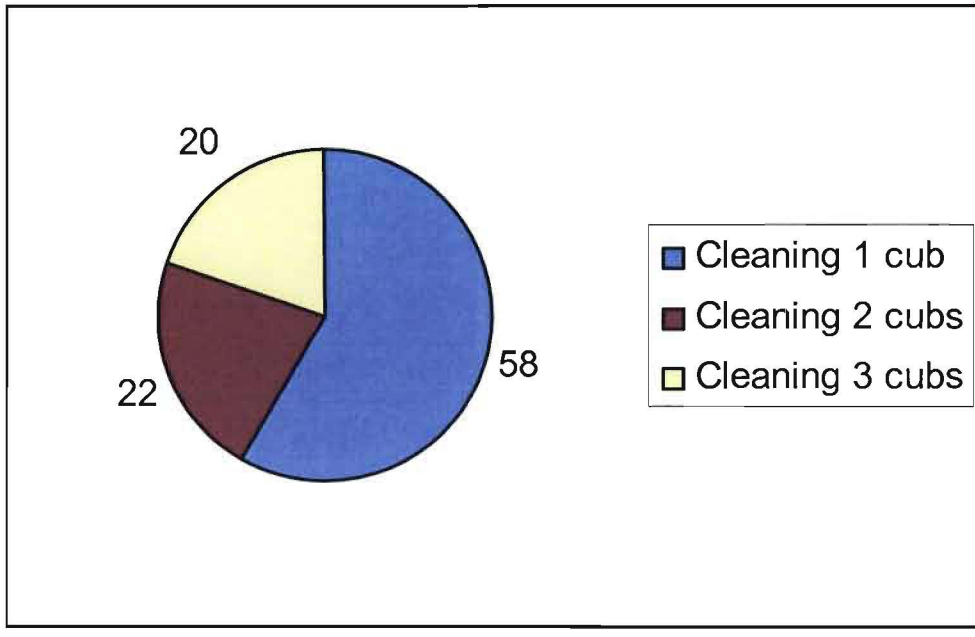

Figure 12. Percent of time devoted to cleaning one, two, or three cubs for week 1.

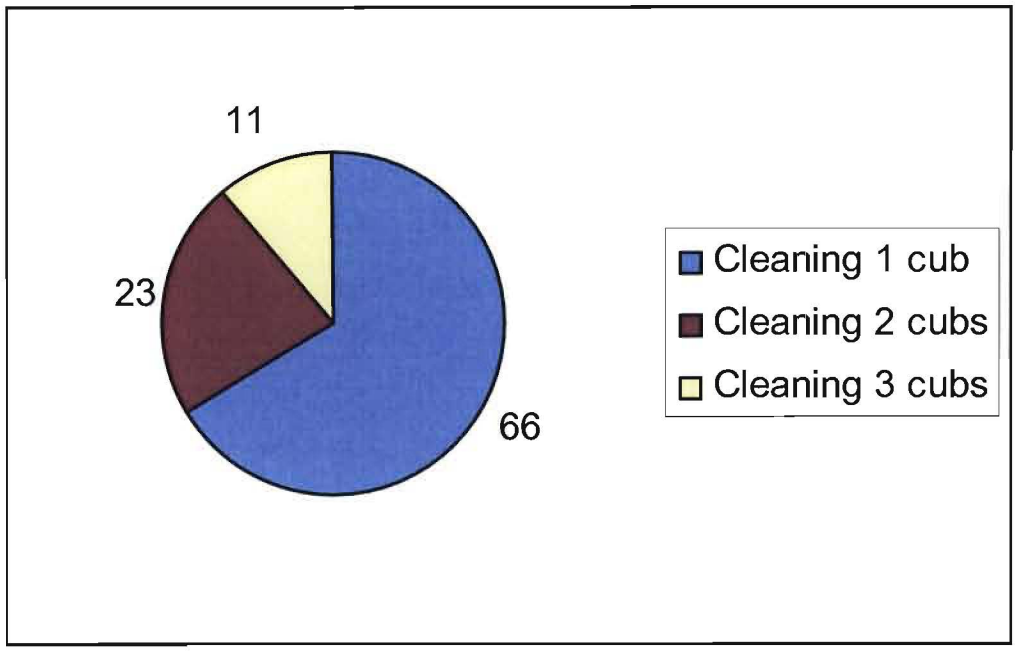

Figure 13. Percent of time devoted to cleaning one, two, or three cubs for week 2.

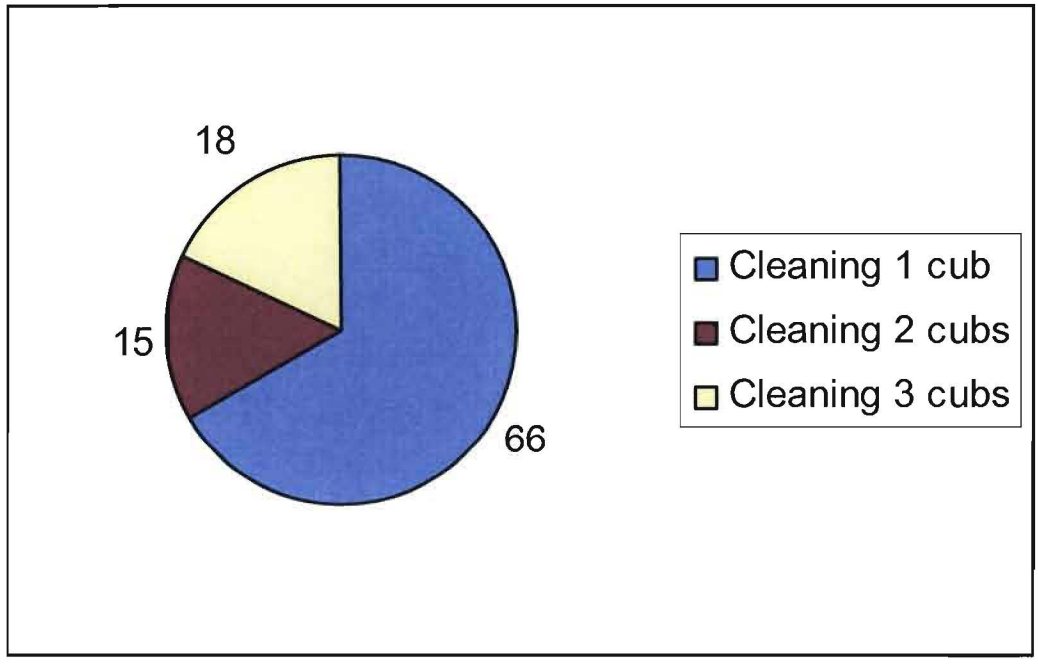

Figure 14. Percent of time devoted to cleaning one, two, or three cubs for week 3.

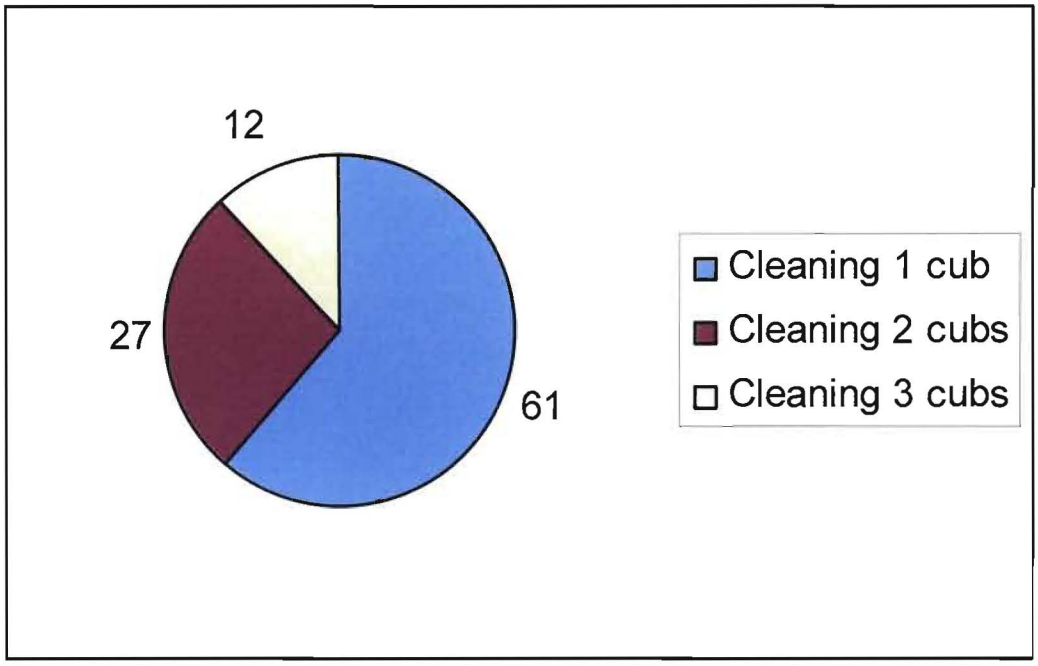

Figure 15. Percent of time devoted to cleaning one, two, or three cubs for week 4

A behavior with no discernable pattern, either by week or by day, was the number of times the mother moved the cubs. In this study moving the cubs was strictly defined as the mother picking up one of the cubs, normally by the nape, and moving that cub to another position in the den. This most often occurred when one of the cubs tried to wander out of the den. This behavior occurred second most often when she wanted to clean one of the cubs. She also tended to move the cubs multiple times in rapid succession, but this may be because one of the cubs would repeatedly try to leave the den. The mother moved the cubs 95, 69, 36, and 70 times in weeks 1, 2, 3, and 4, respectively (Fig. 16).

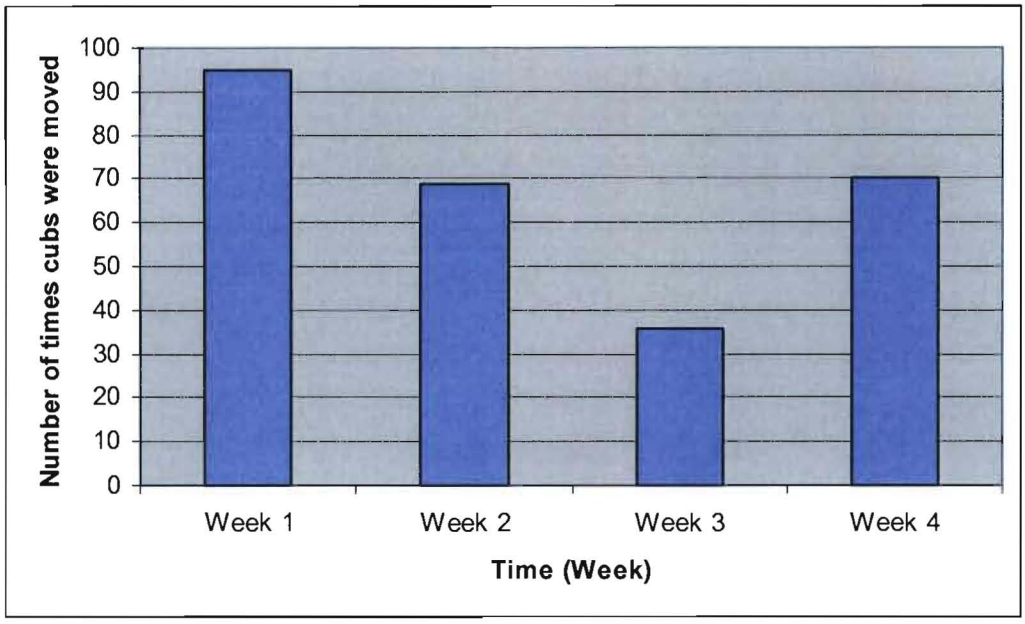

Figure 16. The number of times the mother tiger moved a cub by week.

The amount of time the mother spent outside the den increased week by week (Fig. 17). During the first three weeks, the cubs spent almost all of their time in the den and if they tried to leave the mother would move them back (Fig 18). This suggests that when she was outside she was by herself. In week four one or more of the cubs were outside 47.8% of the time, with two cubs outside of the den 23.7% of the time. All three cubs were outside 10.2% of the time in week four, and one cub was outside 13.9% of the time. By comparison in no other week were any number of cubs outside more than 6.1% of the time (Figs. 19-21).

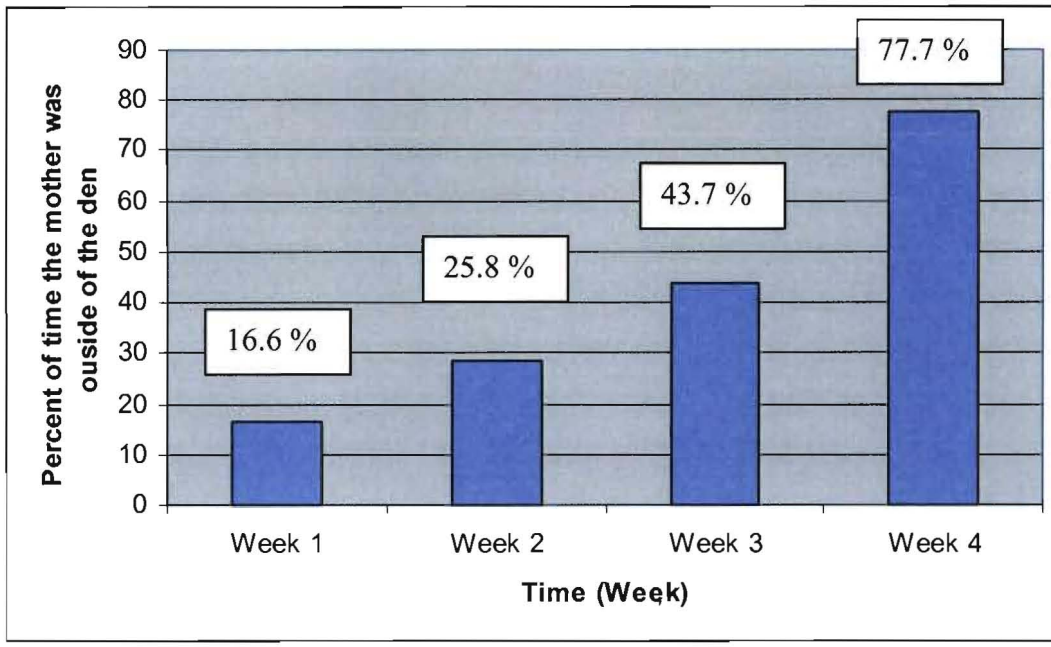

Figure 17. The percent of time the mother tiger spent outside by week.

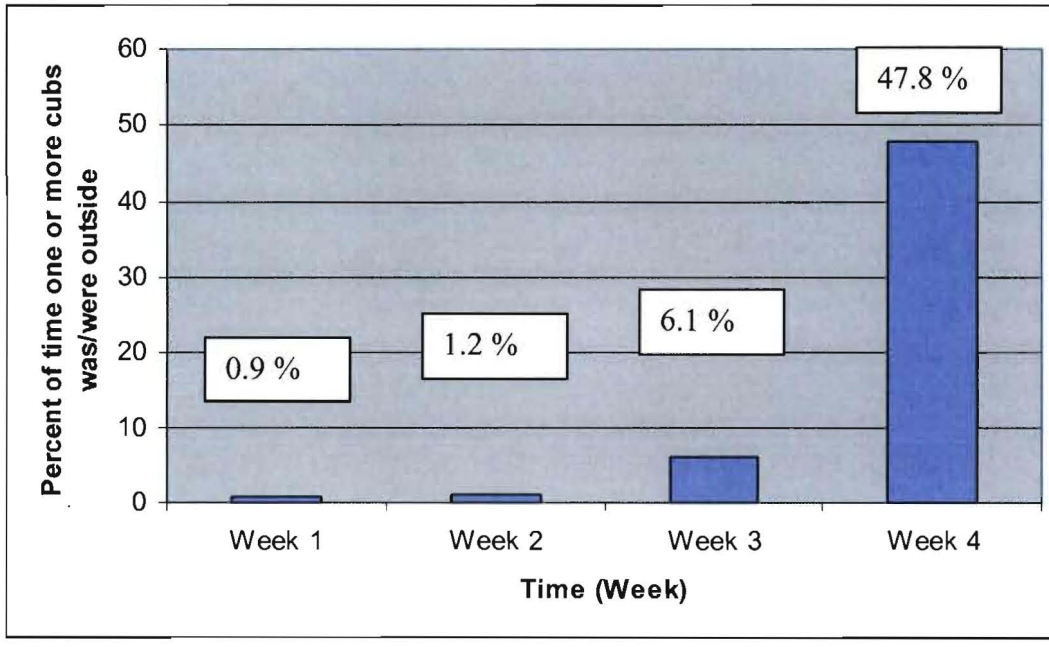

Figure 18. The percent of time one or more of the cubs spent outside by week.

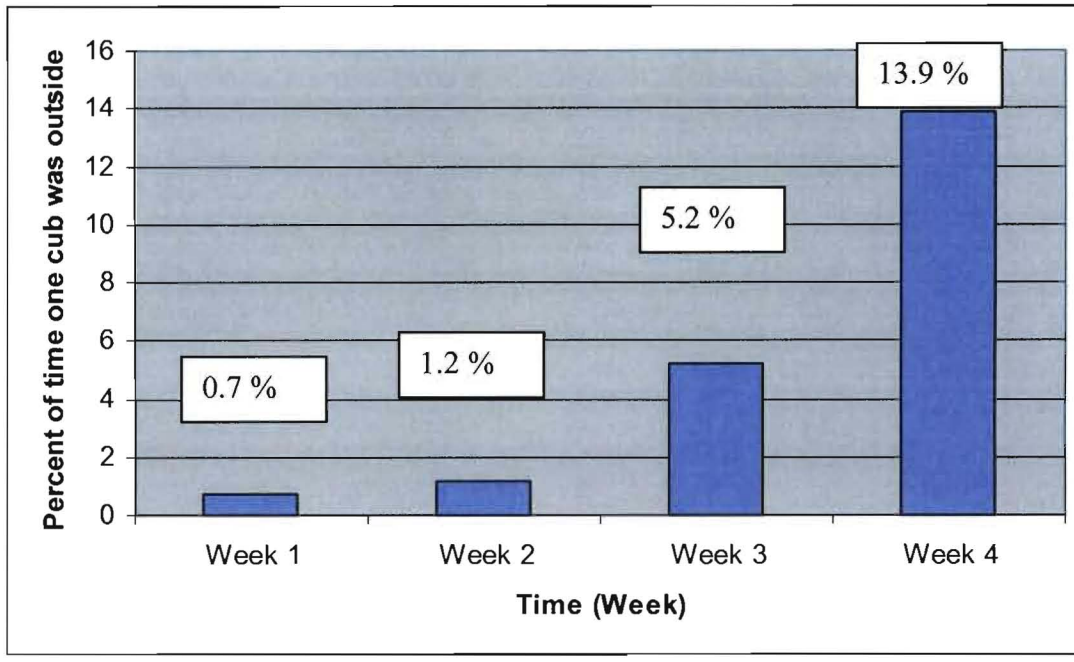

Figure 19. The percent of time one of the cubs was outside by week.

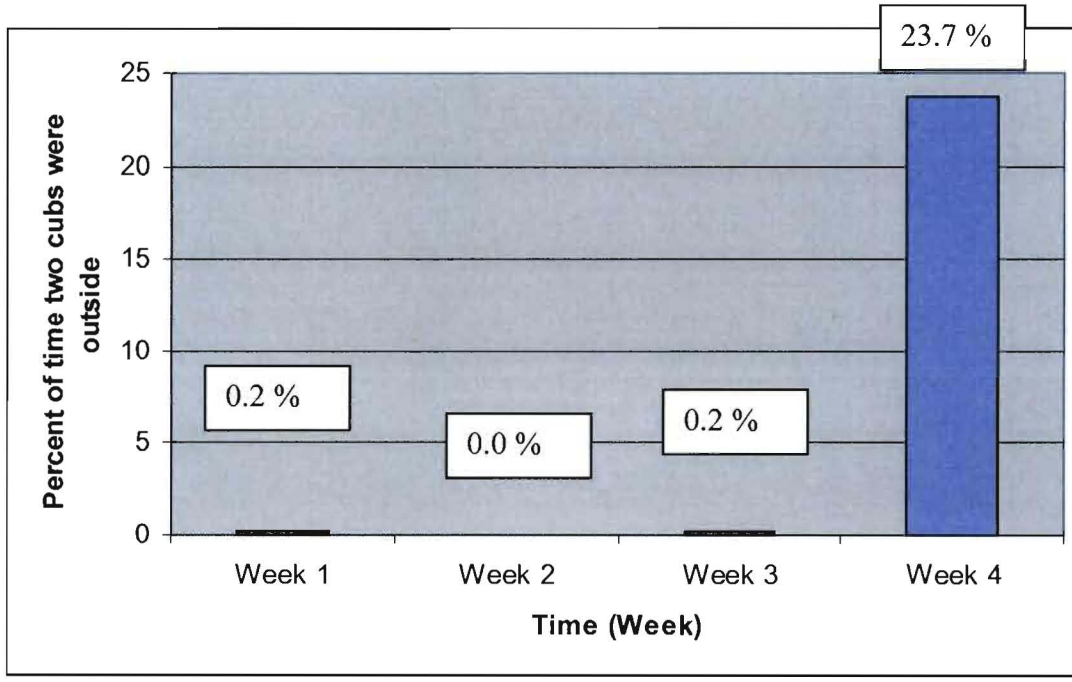

Figure 20. The percent of time two of the cubs were outside by week.

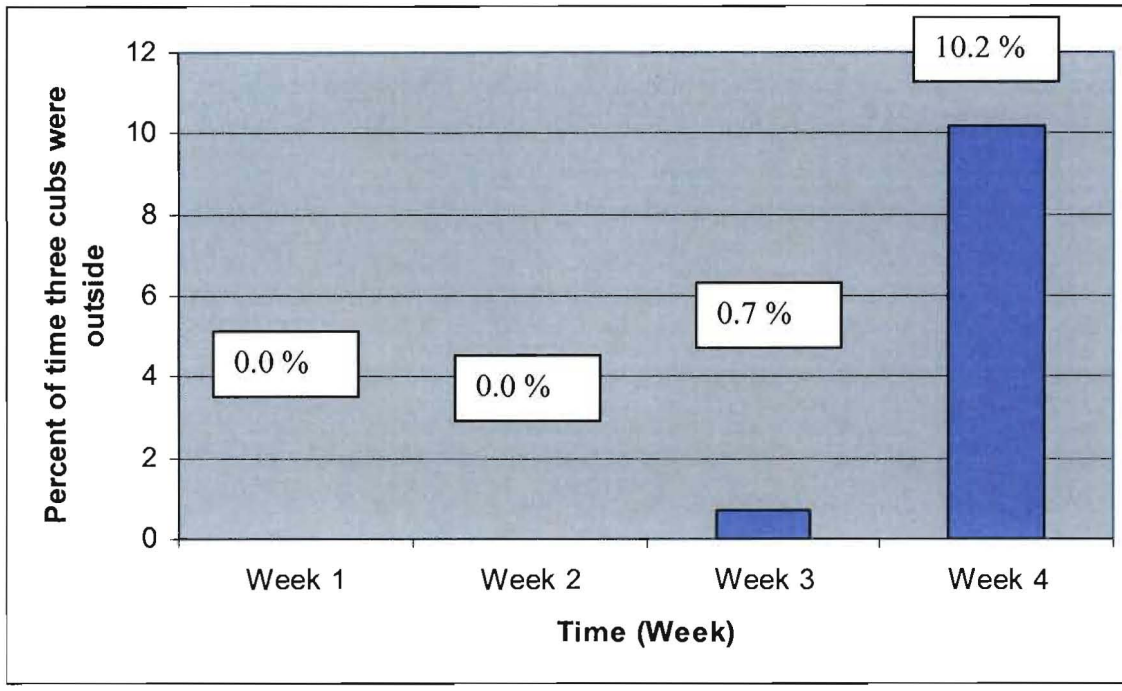

Figure 21. The percent of time all of the cubs were outside by week.

The cubs also displayed some interesting behaviors. In the first two weeks, the cubs spent 31% of their time feeding, which dropped to 22.5% in week 3 and 10. 7% in week 4 (Fig. 22). The cubs spent most of the rest of the time sleeping, though they got more active as the weeks went on. This did not directly translate into playing, however. In week one the cubs spent 3.2% of the time playing, 0.6% in week 2, 1% in week 3, and 1.1% in week four (Fig. 23). A similar trend was observed in the number of times per week the cubs tried to clean themselves. Adding all three cubs attempts, this behavior occurred 7 times in week 1, once in week 2, 3 times in week 3, and 9 times in week 4 (Fig 24). A good portion of the rest of the time was spent sleeping, as each cub slept 60 to 70 percent of the time each week.

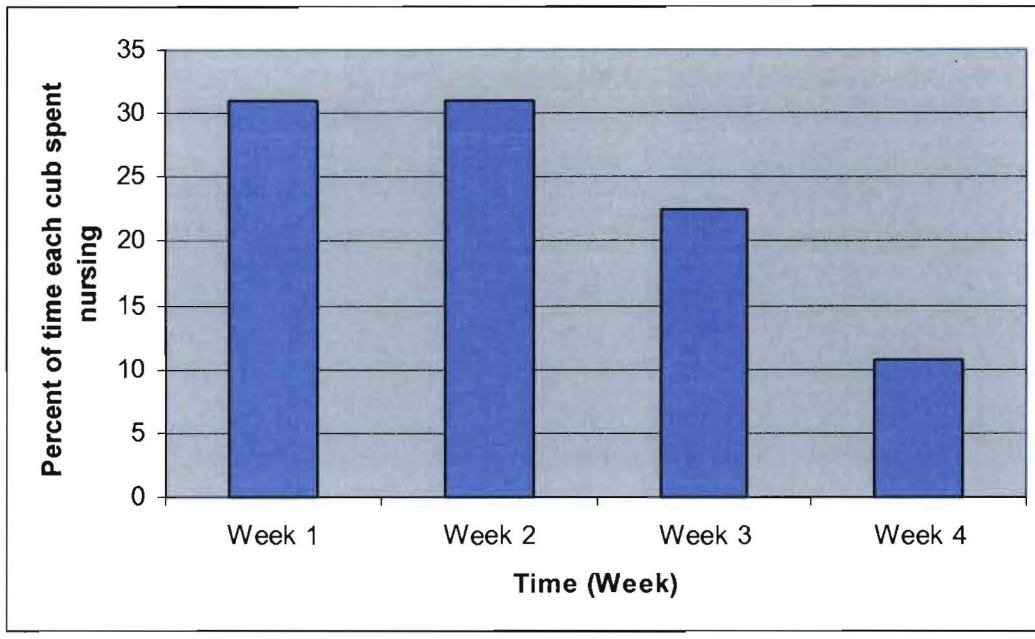

Figure 22. The percent of time each cub spent feeding per week.

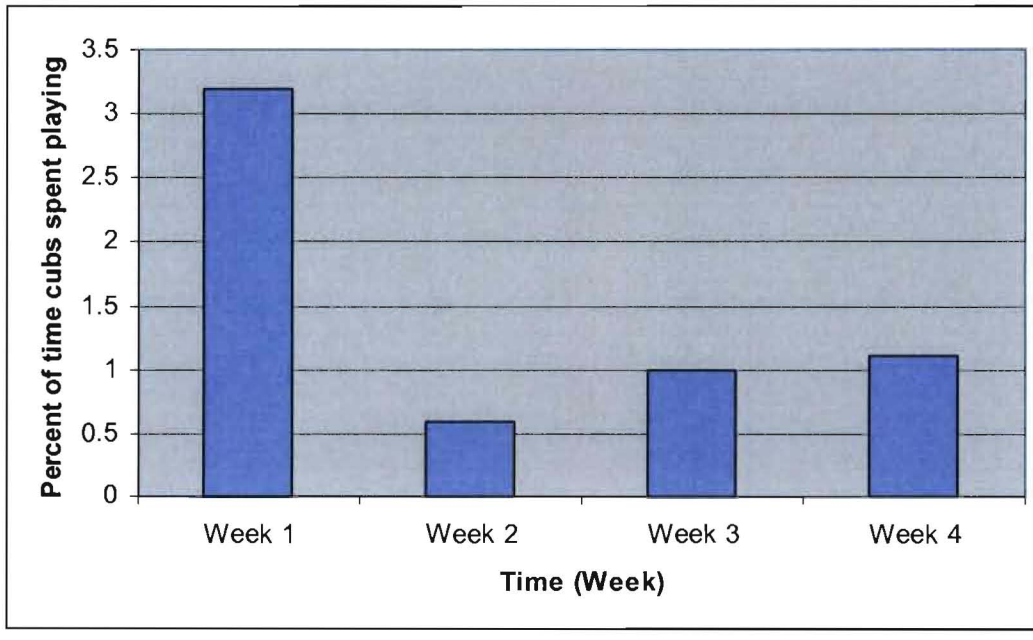

Figure 23. The percent of time two or more of the cubs played with each other, or one or more of the cubs played with their mother.

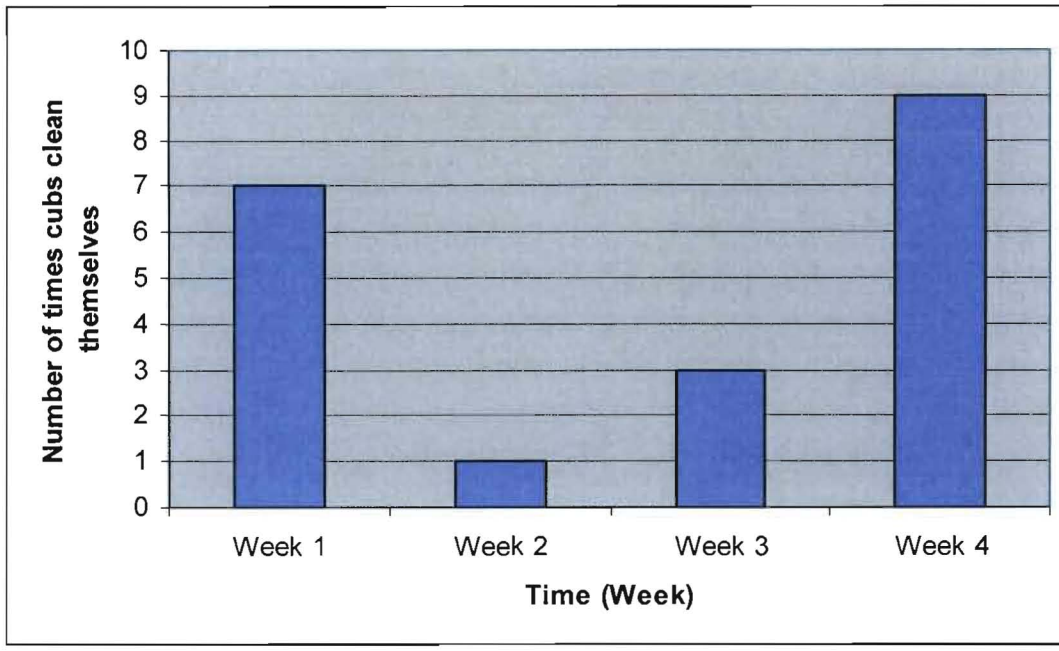

Figure 24. The number of times one of the cubs cleaned itself by week.

There is one more behavior of note. Several times during the first week the mother would bury the cubs under the substrate, sawdust and straw. After the birth of the first cub, the cub was buried, uncovered, and buried again. In the two subsequent births, one cub was buried once and the other not at all. When the mother buried the cubs later on in the week, she did not bury them as deeply as directly after they were born. The remaining times that the cubs were buried it was in all but one case the same cub. This was the most active cub, who was continually trying to crawl out of the den. From the second week on the mother was not observed burying the cubs anymore.

Statistical analysis:

There were no significant differences in any behavioral category between weeks one and two. There were however significant differences between week one and weeks 3 and 4. The amount of time the mother spent nursing the cubs was found to be significantly different between weeks one and four (χ^2=26.40, df=2, p-value<0.001).

There were also significant differences between weeks one and three (χ^2=6.79, df=1, p-value=0.009). There were however, no significant differences in the percent of time the mother devoted to cleaning the cubs, even between weeks one and four (χ^2=0.61, df=1, p-value=0.436). The mother spent significantly more time outside in weeks three and four than in week 1(χ^2=27.78, df=1, p-value<0.001 and χ^2=131.71, df=2, p-value<0.001). There was no significant difference between how much time the mother spent resting in the den between weeks one and three (χ^2=2.94, df=1, p-value=0.086). This did become significant between weeks one and four; however, this is because the mother choose to rest outside the den as opposed to inside it, dropping this category to zero percent of the time (χ^2=33.11, df=1, p-value<0.001). The cubs spent significantly less amount of time nursing in week four than in week 1 (χ^2=8.99, df=1, p-value=0.003). However, no difference was found between the time the cubs spent nursing between weeks 1 and 3 (χ^2=3.49, df=1, p-value=0.062). The cubs were also observed spending more time outside in week four than in week 1 (χ^2=80.17, df=1, p-value<0.001).

Discussion:

The cubs spent most of their time sleeping and eating, whereas the mother spent most of her time feeding and cleaning the cubs during weeks 1 and 2. There is little data on the behavior of the cubs themselves, largely because they exhibit very little behavior until there are several months old. Eating and sleeping is about all that most predatory mammals do when young. This is largely because the cubs are born with their eyes closed and in many cases unable to walk for a few weeks. They do not really become highly active until about three weeks, and do not travel until 8 weeks (Guggisberg 1975). This is consistent with the results of this study, as the cubs did not really try to venture out of the den until the end of their third week of life, or early in their fourth week. This

is somewhat earlier than other studies. One study found that cubs tend to become interested in the outside would at about 35 days of age, or about the fifth week of life (Guggisberg 1975). They also spent very little time playing, which did spike in week four. Playing also spiked in week 1; however, this may have had a lot to do with each cub trying to learn the scent of each other and their mother. Since the cubs' eyes are closed, they will rely heavily on scent to recognize each other and their mother, for about two months, so recognizing each other early is vital.

The cleaning of the cubs has multiple purposes. The first purpose is to simply clean off the cubs. The second purpose is not as obvious. Licking the cubs stimulates the circulation of their blood. This is a well noted fact, and in fact may be vital to starting the circulation of the cubs directly after birth (Guggisberg 1975). A third important function of licking the cubs is to stimulate the cubs to defecate (Tigers 2011). In this study the tigress spent between 8 and 10% of her time cleaning the cubs. This seems to be low, when compared to other studies. In a study at the Minnesota Zoo, researchers watched the birth and interactions of several tigers and their cubs, and found that tigers spent around 15-37% of their time, (average of 24%), cleaning their cubs during the first two weeks of the cubs lives (Bush et al. 2011). Little data exist on what percent of the time a tigress spends cleaning an x number of cubs because the size of tiger litters varies from one to six, making such comparisons of different litters, even from the same mother, very difficult. It is however likely that in any litter, the mother prefers to clean one cub at a time, as in this study, because of inherent difficulty of trying to lick multiple cubs with one tongue.

When it comes to nursing there seems to be great variation in how long the mother spends feeding the cubs. The Minnesota study found that for the first two weeks

the mother would spend 11-58 percent of her time nursing cubs. However, a wild caught tiger at the zoo spent around 60% of her time with cubs in a nursing position (Bush et al. 2011). This study is consistent with the above results, finding that the mother spent around half her time nursing cubs for the first two weeks. Other studies have found that for a few weeks after giving birth the mother will spend up to 70% of her time nursing cubs, which drops to around 30% by the end of the first month (Tigers 2011). This general trend is consistent with the results of this study. The mother spent around 50% of her time nursing cubs for the first two weeks which fell to 35 % in week three, and 18% in week four. However this last week is likely an underestimate because both mother and cubs spent a good deal of time outside the den, and there was not always a clear view of the outdoor enclosure, as the camera was only active a portion of the time. Another study at the Delhi zoo found that for the first week of the cubs lives the mother will spend 70% of daylight hours nursing, which reduces to 60% the next week and 30% by the fourth week (Sankhala 1977). These percentages must be adjusted lower as the study did not include the night time; however, this study found that most feeding happened during daylight hours, so the absolute amount of time feeding may be similar. As with cleaning, there is little data as to how many cubs tend to feed at a time. However it is likely that a tigress will spend most of her nursing time nursing two or less cubs, based not on numerical data but on observation. When all three cubs tried to feed they were having to fight for position, which seemed to bother the mother, who would often move, and then only two cubs would remain feeding.

The change in the amount of time that the mother tiger spends outside, from 15%, to 25%, to 43%, to 77% most likely has a three fold explanation. The first part of the explanations may have its root in wild behavior. As the cubs continue to grow, they are

still reliant on mothers milk. This means to feed them the mother tiger must consume more and more food as the weeks and months pass. This would put greater demand on the mother to hunt, forcing her to spend more time away from her cubs. The second part of the explanation may be that cubs are spending more time outside, allowing the mother more freedom. This however may not reflect nature where the cubs often do not leave the den until two months of age (Sankhala 1977). The third reason is similar, the mother may feel more secure in leaving the cubs, as they are no longer entirely helpless. By weeks two or three the cubs eyesight has become developed, though they will not see as well as an adult until two months, they can now walk, instead of crawl, and have developed milk teeth (Guggisberg 1975). They are still no match for any predator, particularly a large male tiger, but in such a case they can call loudly for the mother. However there was no sound on the tapes viewed for this study so vocalizations were not documented.

Movement of the cubs by the nape is also a well documented behavior. In fact this is the primary method of movement of the cubs early in their lives, and even several months afterward the mother will carry them from den to den by the nape (Guggisberg 1975). The unpredictable nature of these movements in this study, is also consistent. The mother chose to move the cubs when it was convenient for her.

Interestingly snow leopards may exhibit similar behaviors. One study found that a snow leopard (*Uncia uncia*) would spend around 50% of her time nursing cubs in week 1, which would fall to around 35% in week four and 20% in week eight (O'Connor and Freman 1982). However, this same cat showed the opposite behavior for a different litter, going from 9% to 22% from weeks 1 to 4. This low feeding was attributed to the inexperience of the mother. However, their results were consistent for cleaning which

remained constant around 10%, as in this study. This study also found that the mother stayed in the den for most of the first few weeks, and then moved outside more and more in weeks three and four. Again play behavior did not develop in snow leopard cubs until around weeks three, but socialization was seen before that. One major difference was that the mother snow leopard only moved the cubs a handful of times (O'Connor and Freman 1982).

The most interesting behavior noticed in the cubs were their attempts to clean themselves. This is of course to be expected; however, the interesting thing was how early this behavior was observed. The cubs were attempting to clean themselves, though likely not very successfully, as early as the end of the first week. The cubs were clearly copying the behavior of their mother, which is not surprising, though having the muscular control to copy this complex behavior so early was unexpected.

The most interesting behavior noticed in the mother may be easier to explain, though it is more surprising. The mother buried the cubs on several occasions. The first few times this behavior was observed was right after two of the three cubs were born. This leads to one possible explanation that the mother was using the bedding to try and clean and dry off the cubs. The latter examples suggest that the mother could be using the straw and sawdust bedding to try and mask the cubs smell. She may feel the need to do this because in the wild she would move the cubs every few days so predators do not find them (Guggisberg 1975). More interesting perhaps is that this behavior has never been recorded in the literature about tigers. It has however been observed in clouded leopards (*Neofelis nebulosa*). Female clouded leopards line their nest using their own fur (Clouded 2011).

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Week 1	time mother nursing one cub	Percent of time	time nursing two cubs
Tape 16	31	3.2%	19
Tape 17	189	13.7%	281
Tape 18	229	14.5%	395
Tape 19	290	20.0%	440
Tape 20	287	20.2%	500
Tape 21	261	18.0%	498
Tape 22	487	34.0%	227
Total	1774	18.3%	2360

	Average time each cub feeds	Percent of time	# of times cubs clean self
Tape 16	49	5.04%	0
Tape 17	325	23.64%	0
Tape 18	558	35.43%	0
Tape 19	517	35.63%	0
Tape 20	469	33.00%	3
Tape 21	615	42.44%	0
Tape 22	425	29.63%	4
Total	2958	30.57%	7

Week 2	time mother nursing one cub	Percent of time	time nursing two cubs
Tape 23	398	27.9%	357
Tape 24	121	8.9%	432
Tape 25	49	17.9%	62
Tape 26	311	20.0%	449
Tape 27	414	33.4%	137
Tape 28	180	12.5%	226
Total	1473	20.2%	1663

	Average time each cub feeds	Percent of time	# of times cubs clean self
Tape 23	466.6666667	32.68%	0
Tape 24	461	33.95%	0
Tape 25	93	33.94%	0
Tape 26	485	31.13%	0
Tape 27	342.3333333	27.61%	0
Tape 28	425.6666667	29.66%	1
Total	2274	31.18%	1

Percent of time	time nursing three cubs	Percent of time	Total time nursing cubs
2.0%	26	2.7%	76
20.4%	75	5.5%	545
25.1%	218	13.9%	842
30.3%	127	8.8%	857
35.2%	40	2.8%	827
34.4%	196	13.5%	955
15.8%	111	7.7%	825
24.4%	793	8.2%	4927

time cubs spent cleaning themselves	percent	# of times mom covers cubs	
0	0.00%	3	one cub 2x, one once
0	0.00%	0	
0	0.00%	0	
0	0.00%	2	note 2 cubs at once
5	0.35%	1	same cub as above
0	0.00%	0	
4	0.28%	0	
9	0.09%	6	

Percent of time	time nursing three cubs	Percent of time	Total time nursing cubs
25.0%	96	6.7%	851
31.8%	133	9.8%	686
22.7%	35	12.8%	146
28.8%	82	5.3%	842
11.0%	113	9.1%	664
15.7%	215	15.0%	621
22.8%	674	9.2%	3810

time cubs spent cleaning themselves	percent	# of times mom covers cubs
0	0.00%	0
0	0.00%	0
0	0.00%	0
0	0.00%	0
0	0.00%	0
3	0.21%	0
3	0.04%	0

Percent of time	time mother cleaning one cub	Percent	time mother cleaning two cubs	percent
7.8%	60	6.2%	26	2.7%
39.6%	44	3.2%	33	2.4%
53.5%	77	4.9%	17	1.1%
59.1%	58	4.0%	27	1.9%
58.2%	87	6.1%	35	2.5%
65.9%	97	6.7%	34	2.3%
57.6%	141	9.8%	41	2.9%
50.9%	564	5.8%	213	2.2%

Percent of time	time mother cleaning one cub	Percent	time mother cleaning two cubs	percent
59.6%	104	7.3%	32	2.2%
50.5%	67	4.9%	34	2.5%
53.5%	11	4.0%	10	3.7%
54.0%	86	5.5%	31	2.0%
53.5%	88	7.1%	25	2.0%
43.3%	96	6.7%	28	2.0%
52.2%	452	6.2%	160	2.2%

time mother cleaningthree cubs	percent	total time cleaning cub	percent	time mother cleaning self
28	2.9%	114	11.7%	14
81	5.9%	158	11.5%	37
26	1.7%	120	7.6%	33
29	2.0%	114	7.9%	33
4	0.3%	126	8.9%	30
19	1.3%	150	10.4%	25
11	0.8%	193	13.5%	39
198	2.0%	975	10.1%	211

time mother cleaningthree cubs	percent	total time cleaning cub	percent	time mother cleaning self
2	0.1%	138	9.7%	30
8	0.6%	109	8.0%	10
4	1.5%	25	9.2%	2
37	2.4%	154	9.9%	18
6	0.5%	119	9.6%	13
13	0.9%	137	9.5%	16
70	1.0%	682	9.4%	89

percent	time mom spends outside	percent	time one cub outside	percent	time two cubs outside
1.4%	97	10.0%	1	0.1%	0
2.7%	270	19.6%	15	1.1%	0
2.1%	314	19.9%	8	0.5%	16
2.3%	290	20.0%	2	0.1%	0
2.1%	161	11.3%	10	0.7%	0
1.7%	321	22.2%	10	0.7%	0
2.7%	154	10.7%	20	1.4%	1
2.2%	1607	16.6%	66	0.7%	17

percent	time mom spends outside	percent	time one cub outside	percent	time two cubs outside
2.1%	301	21.1%	27	1.9%	2
0.7%	401	29.5%	13	1.0%	0
0.7%	63	23.1%	0	0.0%	0
1.2%	363	23.3%	7	0.4%	0
1.0%	303	24.4%	23	1.9%	0
1.1%	454	31.6%	19	1.3%	0
1.2%	1885	25.8%	89	1.2%	2

percent	three cubs outside	percent	# of times mom moves cubs	time cubs play with eachother
0.0%	0	0.0%	2	27
0.0%	0	0.0%	4	80
1.0%	0	0.0%	15	23
0.0%	0	0.0%	1	14
0.0%	0	0.0%	23	15
0.0%	0	0.0%	24	18
0.1%	0	0.0%	26	22
0.2%	0	0.0%	95	199

percent	three cubs outside	percent	# of times mom moves cubs	time cubs play with eachother
0.1%	0	0.0%	27	14
0.0%	0	0.0%	10	0
0.0%	0	0.0%	1	0
0.0%	0	0.0%	6	3
0.0%	0	0.0%	13	0
0.0%	0	0.0%	12	13
0.0%	0	0.0%	69	30

percent	time mom and cubs play	percent	total time
2.8%	38	3.9%	972
5.8%	22	1.6%	1376
1.5%	14	0.9%	1574
1.0%	3	0.2%	1451
1.1%	2	0.1%	1421
1.2%	15	1.0%	1449
1.5%	13	0.9%	1433
2.1%	107	1.1%	9676

percent	time mom and cubs play	percent	total time
1.0%	4	0.3%	1428
0.0%	1	0.1%	1359
0.0%	0	0.0%	273
0.2%	5	0.3%	1558
0.0%	0	0.0%	1240
0.9%	3	0.2%	1435
0.4%	13	0.2%	7293

Week 3	time mother nursing one cub	Percent of time	time nursing two cubs
Tape 29	334	23.7%	235
Tape 30	146	12.0%	161
Tape 31	148	9.8%	134
Tape 32	178	12.7%	268
Tape 33	130	8.8%	259
Tape 34	131	9.1%	85
Total	1067	12.6%	1142

	Average time each cub feeds	Percent of time	# of times cubs clean self
Tape 29	454	32.20%	2
Tape 30	379	31.27%	0
Tape 31	295	19.46%	1
Tape 32	270	19.29%	0
Tape 33	281	19.04%	0
Tape 34	219.3333333	15.24%	0
Total	1898	22.46%	3

Week 4	time mother nursing one cub	Percent of time	time nursing two cubs
Tape 35	47	3.3%	114
Tape 36	84	5.5%	49
Tape 37	125	6.8%	100
Tape 38	127	11.4%	81
Tape 39	140	8.4%	121
Total	523	6.9%	465

	Average time each cub feeds	Percent of time	# of times cubs clean self
Tape 35	126.6666667	8.80%	1
Tape 36	61	3.99%	2
Tape 37	178	9.75%	2
Tape 38	245.3333333	22.10%	1
Tape 39	202.3333333	12.08%	3
Total	813	10.74%	9

Percent of time	time nursing three cubs	Percent of time	Total time nursing cubs
16.7%	186	13.2%	755
13.3%	223	18.4%	530
8.9%	156	10.3%	438
19.1%	32	2.3%	478
17.5%	65	4.4%	454
5.9%	119	8.3%	335
13.5%	781	9.2%	2990

time cubs spent cleaning themselves	percent	# of times mom covers cubs
5	0.35%	0
0	0.00%	0
2	0.13%	0
0	0.00%	0
0	0.00%	0
0	0.00%	0
7	0.08%	0

Percent of time	time nursing three cubs	Percent of time	Total time nursing cubs
7.9%	35	2.4%	196
3.2%	0	0.0%	133
5.5%	70	3.8%	295
7.3%	149	13.4%	357
7.2%	75	4.5%	336
6.1%	329	4.3%	1317

time cubs spent cleaning themselves	percent	# of times mom covers cubs
1	0.07%	0
2	0.13%	0
3	0.16%	0
1	0.09%	0
5	0.30%	0
12	0.16%	0

Percent of time	time mother cleaning one cub	Percent	time mother cleaning two cubs	percent
53.5%	90	6.4%	10	0.7%
43.7%	71	5.9%	30	2.5%
28.9%	89	5.9%	12	0.8%
34.1%	86	6.1%	18	1.3%
30.8%	62	4.2%	20	1.4%
23.3%	87	6.0%	23	1.6%
35.4%	485	5.7%	113	1.3%

Percent of time	time mother cleaning one cub	Percent	time mother cleaning two cubs	percent
13.6%	77	5.4%	26	1.8%
8.8%	42	2.8%	17	1.1%
16.1%	38	2.1%	27	1.5%
32.2%	58	5.2%	23	2.1%
20.1%	67	4.0%	33	2.0%
17.4%	282	3.7%	126	1.7%

time mother cleaningthree cubs	percent	total time cleaning cub	percent	time mother cleaning self
26	1.8%	126	8.9%	26
14	1.2%	115	9.5%	26
31	2.0%	132	8.7%	32
19	1.4%	123	8.8%	17
28	1.9%	110	7.5%	18
15	1.0%	125	8.7%	20
133	1.6%	731	8.6%	139

time mother cleaningthree cubs	percent	total time cleaning cub	percent	time mother cleaning self
10	0.7%	113	7.9%	0
4	0.3%	63	4.1%	8
11	0.6%	76	4.2%	5
19	1.7%	100	9.0%	30
9	0.5%	109	6.5%	39
53	0.7%	461	6.1%	82

percent	time mom spends outside	percent	time one cub outside	percent	time two cubs c
1.8%	374	26.5%	0	0.0%	0
2.1%	464	38.3%	0	0.0%	0
2.1%	653	43.1%	110	7.3%	8
1.2%	669	47.8%	150	10.7%	8
1.2%	748	50.7%	93	6.3%	0
1.4%	782	54.3%	84	5.8%	3
1.6%	3690	43.7%	437	5.2%	19

percent	time mom spends outside	percent	time one cub outside	percent	time two cubs c
0.0%	1096	76.2%	95	6.6%	79
0.5%	1292	85.0%	314	20.7%	591
0.3%	1482	81.0%	350	19.1%	563
2.7%	786	70.8%	55	5.0%	175
2.3%	1230	73.4%	235	14.0%	389
1.1%	5886	77.7%	1049	13.9%	1797

percent	three cubs outside	percent	# of times mom moves cubs	time cubs play with eachother
0.0%	0	0.0%	2	5
0.0%	0	0.0%	0	15
0.5%	0	0.0%	9	0
0.6%	0	0.0%	13	13
0.0%	0	0.0%	3	0
0.2%	56	3.9%	9	23
0.2%	56	0.7%	36	56

percent	three cubs outside	percent	# of times mom moves cubs	time cubs play with eachother
5.5%	208	14.5%	8	16
38.9%	125	8.2%	14	9
30.8%	111	6.1%	21	25
15.8%	178	16.0%	12	7
23.2%	150	9.0%	15	20
23.7%	772	10.2%	70	77

percent	time mom and cubs play	percent	total time
0.4%	3	0.2%	1410
1.2%	0	0.0%	1212
0.0%	0	0.0%	1514
0.9%	2	0.1%	1400
0.0%	10	0.7%	1476
1.6%	7	0.5%	1439
0.7%	22	0.3%	8451

percent	time mom and cubs play	percent	total time
1.1%	0	0.0%	1439
0.6%	0	0.0%	1520
1.4%	0	0.0%	1829
0.6%	6	0.5%	1110
1.2%	5	0.3%	1675
1.0%	11	0.1%	7573

Maternal Behavior in tigers: How do tigers allocate time?

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Abstract:

I conducted a project on the maternal behavior of tigers, focusing on time allocation. This study is important because tigers are a critically endangered species, and healthy captive populations may be their only future. The study involved watching videotapes of a mother tiger who had just given birth at the Ft. Wayne Zoo, and record all behaviors of her and the cubs. Data were analyzed and compared to similar studies, and explanations are proposed for unexpected behaviors, such as covering the cubs. Early in the month, most of the time was spent feeding but later the mother spent a lot of time outside.

Introduction:

Tigers are a critically endangered species. In fact there may be more captive cats in the United States than in the wild. This means that the survival of the species may depend on captive breeding programs, like those found in many zoo's. In order for captive breeding programs to be successful it is necessary to understand the breeding biology of the species, particularly the care of young. The objective of this study was to understand how captive tigers interact and raise their young cubs.

Study area:

The subjects in this study, the mother and three cubs, were contained in two connected enclosures.

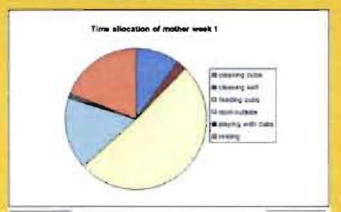
The first was completely indoor and used as the den. The second had three solid walls, with a fence forming an open fourth wall. This provides a semi open look to the enclosure and allows the keepers to view the mother tiger. It also allows the keepers access to the enclosure.

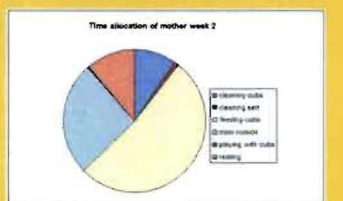
Methods:

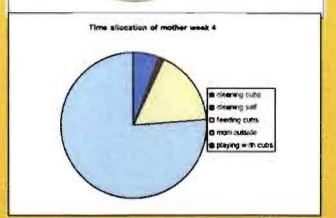
The Fort Wayne Zoo filmed the birth of tiger cubs and the mothers interaction with her cubs. I watched copies of these videotapes and recorded behaviors such as feeding and cleaning over the first month of the cubs lives. I transferred my data from data sheets into an excel spreadsheet. Several graphs were constructed to aid in analyzing data. About 550 hours of videotape were analyzed, with each tape containing on average 23 hours of film. Also, the camera in each enclosure was remotely mounted in a corner so as not to interfere with the cats natural behavior.

Results:

This study found several interesting results. During the first week of the study, the mother devoted most of her time to feeding, and as the weeks progressed, the amount of time she spent feeding the cubs dropped dramatically and quickly. Also noted was the amount of time both the mother and the cubs spent outside. During the first week, the mother spent little time outside, whereas by week four, she was spending most of her time outside. The cubs also spent very little time outside during the first, second, and third weeks, but spent a good deal of time outside during week four. The following graphs show how the mother allocated her time during each of the four weeks:







There were several other interesting behaviors demonstrated by the mother. The most interesting of these behaviors was when the mother buried the cubs under the sawdust and straw bedding. This behavior occurred four to five times. The first two incidents were right after two of the cubs were born. The other times were observed within the first two weeks of birth. One interesting behavior displayed in the cubs were their attempts to clean themselves, which occurred several times over four weeks.

Discussion:

The behaviors noted in the results section appear to be consistent with the published literature, and for the most part, consistent with nature. Similar behaviors has been recorded in tigers, as well as other large cats (Tigers 2011, O'Connor et al. 1982). The mother probably spent more time outside, to simulate time spent hunting. The decrease in time feeding the cubs is again likely related to time spent hunting in the wild. The most interesting behavior, the burying of the cubs, may be explained by the need to protect the cubs. The material appears to be absorbent and the mother may be trying to use it to block the smell of the cubs.

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The Ft. Wayne Zoo

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